URINE MY GARDEN

Gardener Guide to Fertilizing with Urine

Discover why & how to reclaim the nutrients from your body for a flourishing home garden and healthier watershed!

Introduction: Liquid Gold for Your Garden

Human urine contains the vital nutrients that plants need to thrive. When we flush these precious elements downstream, they are not only wasted but become pollutants that impair waterways, kill fish, and threaten drinking water. Instead, by collecting your urine (liquid gold!), your "waste" becomes a valuable resource.

Urine fertilization has ancient roots and is practiced in many communities around the world today. By reconnecting linear nutrient flows back into the food nutrient cycle, we can transform a system of extraction and pollution into a cycle of abundance!

> "Give a gift, in reciprocity for what you have taken. Sustain the ones who sustain you and the earth will last forever."
> — Robin Wall Kimmerer, *Guidelines for the Honorable Harvest*

To learn more about nutrient cycling at larger scales, see:

- Farmer Guide to Fertilizing with Urine
- Community Guide to Urine Diversion Programs

Why Fertilize with Urine?

- **Create Fertilizer:** Urine fertilization reduces dependence on fossil-fuel-intensive synthetic fertilizers. The nutrients in your daily pee are enough to grow wheat for a whole loaf of bread!
- **Prevent Pollution:** Separating urine at the source can remove up to 75% of nitrogen and 55% of phosphorus from wastewater.
- **Conserve Water:** Every 5 gallons of urine collected conserves 100 gallons of flush water (about 4,000 gallons per person per year).

Reclaim…

- what has been cast off as “waste” as a source of abundance
- a simple practice that has sustained communities for generations
- our role in the food system as not just consumers but forces of creation
- the power of our bodies to heal rather than harm the earth

Properties of Urine Fertilizer

Nutrient Content

Urine is rich in nutrients, including the macronutrients nitrogen, phosphorus, and potassium, as well as secondary and micronutrients. Urine has an NPK value of 0.6-0.1-0.2. One gallon of urine contains 0.05 lbs nitrogen, 0.008 lbs phosphorus, and 0.017 lbs potassium. Agricultural field trials, including Rich Earth’s own research with hay, have demonstrated that urine fertilizer provides crop yields comparable to synthetic fertilizers of the same nitrogen content.

A Note on Pee vs. Poo:
While urine is used as a fertilizer, poop is rich in organic matter and can also be used as a soil amendment. Different state rules may apply to composting “humanure.”

Ammonia Volatilization

The main form of nitrogen in urine is urea, which is naturally converted to ammonia once it leaves the body. Ammonia is highly volatile, meaning it can easily evaporate out of the urine as ammonia gas when stored in an unsealed container.

To prevent ammonia volatilization from occurring–and retain the nitrogen content of your urine fertilizer–it is important to take care when storing urine and when applying it to soil. This can be done through storing urine in airtight containers, minimizing spraying during application, and integrating urine into the soil.

Salt Accumulation

Urine contains significant levels of salt, but this isn’t generally a problem for gardeners in humid climates, including the Northeast. In these climates, annual precipitation is greater than soil evaporation, with the result that rainwater/snowmelt will wash the salts out of the topsoil, preventing buildup of salt in the root zone.

However, if you are growing in an enclosed environment, like a greenhouse, or in an arid or semi-arid region, build-up of salts is a potential concern. We do not yet have recommendations for using urine in these environments. If you want to try it, be sure to monitor your soil for salt accumulation. If salt becomes a problem, you can periodically flush the soil with water through irrigation or a sprinkler system to correct it.

Effect on Soil pH

Urine is an ammonia-based fertilizer, and soil science suggests that adding ammonia to soil will either: 1) have no lasting effect on pH if plants absorb and utilize all the nitrogen from the fertilizer or 2) cause a drop in pH if a substantial portion of the nitrogen leaches out of the soil before it can be absorbed by the crop, due to excess irrigation or rainfall. These effects are related to the natural soil process that converts ammonia into nitrate.

Safety

Pathogens:

Urine is typically very low in pathogens (though not truly sterile). The primary pathogen risk comes from urine collected via urine-diverting toilets, where fecal contamination is possible. Guidelines published by the World Health Organization in 2006 specify that urine from a single household can safely be used on home gardens without any pre-treatment. (If you live with someone who is sick, you are far more likely to be infected by sharing a household/bathroom with them than through a urine fertilization pathogen pathway.)

Heavy metals:

Heavy metals are low to non-detectable in urine; much lower than some other common fertilizers, such as commercial phosphate fertilizers, manure, and biosolids.

Pharmaceuticals:

Urine can contain pharmaceutical residues. When we flush urine into wastewater systems, these chemical compounds are generally not removed and accumulate in downstream water bodies with disruptive effects on the species who live there. By diverting urine from the wastewater stream, we can protect these sensitive aquatic ecosystems and water supplies.

When urine is applied to the soil as a fertilizer, our own research and a number of other studies have not found pharmaceuticals to accumulate in crop tissues at significant levels. While there are some pharmaceutical compounds detectable in crop tissue, the levels are extremely small–in the nanogram per gram (or parts per billion) range. Perhaps unsurprisingly, caffeine is by far the most abundant drug found in human urine. But the molecule is present in such tiny

amounts in urine-fertilized lettuce that you would have to eat a pound every day for 1,000 years to ingest the equivalent of one cup of coffee. The levels of other pharmaceutical compounds are even lower than this.

Research findings suggest that soil microbes may be helping to break down the pharmaceuticals. Rich Earth is now conducting research to better understand how urine fertilization affects microbial communities.

PFAS

Some levels of PFAS may be present in urine, since they are common in human blood and leave the body slowly over time, mostly through urine. A study of highly exposed individuals found an average PFOA concentration of 27 ng/L in urine. Recent third-party testing of urine collected through two community-scale programs in Vermont (operated by Rich Earth Institute and by Wasted*) revealed no detectable PFOA, PFOS, or other regulated PFAS compounds.

How to Fertilize with Urine

1: Collect

Collect your urine in a watertight, airtight container–this will prevent smelling and leaking, as well as nitrogen loss during storage.

Rich Earth has designed a Portable Peecycler, which can be used for standing or squatting collection. A ball sits in the funnel, acting as a valve-check to allow urine to enter and prevent odor from escaping. Some use the funnel in conjunction with a stand-to-pee device (such as the pStyle) or collect their urine in a nun's cap to pour into the funnel. The portable peecycler is available on Etsy.

Our partner Toilets for People now sells a seated version, available at toieltsforpeople.com

Many gardeners simply use recycled containers such as wide-mouthed laundry detergent bottles, kitty litter containers, or milk jugs.

Odor

Often, simply collecting urine in an airtight container is sufficient to prevent odors. If you notice a smell, you can optionally add 1-2 cups of white vinegar or 1 tablespoon of citric acid to your empty container before you start collecting.

2: Sanitize

Urine from healthy people is generally pathogen free. For home gardeners, **urine fertilizer does not need to be sanitized.** Many people use urine in their home gardens without any treatment. The World Health Organization supports this practice if the urine comes from the same household that will be eating the produce, and if the following guidelines are followed:

1. Wash hands after handling urine, or wear gloves
2. Follow best practices for collection and application
3. Wait at least one month (30 days) after fertilization to harvest crops that you'll eat raw (such as leafy greens)

However, **sanitization is necessary** for growing food for public consump-tion. Contexts such as farms, community gardens, or schools should consult with your local or state regulatory agencies about any permits that may be required...

To sanitize your urine at home, simply store it in an airtight container at 68°F (20°C) or higher for six months. This will raise the pH in the urine high enough to kill any potential pathogens.

The Rich Earth Institute sanitizes our community-collected urine via pasteurization, heating the urine to 176°F (80°C) degrees for 1.5 minutes (US EPA method). This urine pasteurizer is available for larger-scale contexts via our spin-off company, Brightwater Tools.

3: Fertilize

When working with any fertilizer, it's helpful to keep in mind the "4R's" of nutrient stewardship: right source, right rate, right time, and right place. Having already delved into the source (the fertilizer factory within!), let's take a look at the remaining three factors.

Right Rate

Any plant with high nitrogen needs is a prime recipient for urine fertilizer–such as corn, tomatoes, and leafy greens. Many other crops–such as peppers, broccoli, cut flowers, shrubs, fruit and nut trees, and conifers–can also benefit from the range of nutrients in urine. To fertilize trees, apply the urine in a circle that is the same diameter as the tree's canopy (to estimate where the roots of the tree are growing below ground). Nitrogen-fixing plants such as legumes don't need to be fertilized with urine.

Some gardeners feel more comfortable starting with ornamental plants—like flowers, bushes, or grass— before trying urine on food crops. You can even use it on dye plants like indigo, as a way of enjoying the beauty of the nutrient cycle with your eyes rather than taste buds.

Figuring out how much urine fertilizer to apply is a match- making exercise between:

1. **Nutrient content of urine and any other amendments applied.** *Urine is largely a fast-acting high-nitrogen fertilizer* *- see page 2.*

2. **Nutrient content of your soil.** *State extension offices can provide soil tests and make recommendations.*
3. **Nutrient needs of your plants.** *For crop-specific recommendations, check out Cornell University's Nutrient Guidelines for Vegetables.*

Rich Earth's urine fertilizer calculator creates plant-specific guidelines for how much urine to apply per garden bed or square foot. Gardeners can use the calculator to create customized application recommendations by making a copy of the spreadsheet linked on our home gardening webpage: tinyurl.com/UrineMyGarden

Right Time

Most crops should be fertilized with urine during their more active growth stage. Generally, this means when the plant is older than a seedling but before it begins flowering or fruiting. When you plant the seedlings, you can provide them a small amount of dilute urine. After that, apply the urine in several small applications spread out over the growing period, rather than one large application. This provides the plants with nutrients as they need them, and gives them time to take up the nutrients before the excess runs off as pollution.

Right Place

Apply urine directly to the soil rather than onto the plant to avoid nitrogen burning. Since the nitrogen in urine is easily lost to the air (through ammonia volatilization) it is important to incorporate the urine into soil as quickly as possible. This can be done through a few different methods:

- Apply urine in a hole or furrow at least 4" from the base of each plant and cover with soil
- Irrigate after application or apply during rain
- Dilute urine before application

Dilution:

Many gardeners dilute their urine with water before applying. While this is not always a necessary step, it helps the urine soak into the soil, which is especially important in dry soil. Dilution can also help reduce the odor of the urine fertilization experience. Suggested dilution ratios (urine:water) range from 1:1 to 1:10, depending on the fertilization context and the dryness of the soil.

Reci-pees: Combining Urine with Other Amendments

Urine + Compost

Adding urine can be an effective way to increase the nitrogen in a compost pile. If you have a high carbon content compost heap (mostly straw, dead leaves, sawdust, or other dry, dead plant material), then it will retain the nitrogen in urine fertilizer - and the urine can actually help accelerate the composting process. However, if you have a very green compost pile already (mostly kitchen scraps or green plant. material), then too much nitrogen can cause the pile to

heat up too fast, kill microorganisms, and emit greenhouse gases such as methane and nitrous oxide.

Urine + Biochar

Biochar is a charcoal-like substance with high capacity for retaining nutrients and storing carbon. Biochar can adsorb the nutrients in urine, keeping nutrients in the soil for longer.

Urine + Wood Ash

To give your soil an extra boost of potassium, wood ash is a great option. Don't mix urine with wood ash (it will make the ammonia more volatile) but rather add both amendments separately to your garden bed as needed.

Urine + Straw Bales

Enriching a straw bale with urine fertilizer can accelerate the decomposition process and feed soil microbes.

Urine + Wood Chips

Urine can help biodegrade woody material and slow down their release of nitrogen.

Urine + Wool

Sheep wool can be paired with urine fertilizer to help the soil hold moisture while slowly releasing additional nitrogen as the wool decomposes.

Urine + Fermentation

Fermenting urine lowers its pH, turning more ammonia into plant-available ammonium and reducing nitrogen loss via ammonia volatilization. One way to do this is by adding small amounts of acid whey (a dairy by-product) and a starter culture, like a probiotic pill. Our research trials found that low whey rates (1 part whey to 8–16 parts urine) gave the best nitrogen retention for the amount used. Fermentation works faster in warm temperatures and slower in cooler ones.

Bonus Uses in the Garden

Aside from the benefits of fertilizing with urine, many home gardeners have reported additional uses for urine in the garden. (Rich Earth has not tested these potential benefits ourselves).

Pest Deterrent:

Many gardeners report that fertilizing with urine can help reduce insect damage. One gardener said urine fertilization "helps the eggplants to outgrow the flea beetles." Some people also

recommend pouring urine around the perimeter of the garden to discourage animals from entering or pouring about a gallon of urine down woodchuck holes, and repeating over several days. One study from the National Institute of Agricultural Research in Niger looked into the effectiveness of urine in deterring cowpea pests, finding that urine performed significantly better than the non-treated control, though worse than neem oil and synthetic pesticide.

Herbicide:

As anyone knows who's witnessed dog pee turn patches of lawn yellow, urine can also kill plants. This is a case of "too much of a good thing." Urine can act as an herbicide to undesired plants through nitrogen burning. One gardener reported that repeated applications of urine to Japanese knotweed (in conjunction with covering the knotweed with tarps) eventually achieved near eradication on their property. If urine is applied as an herbicide, it is important to consider application location to prevent contributing to nutrient pollution in nearby streams or other bodies of water.

Scaling Up Urine Recycling

At scale, urine diversion can be a powerful tool to reduce nutrient pollution in sensitive watersheds and provide local farmers with sustainable fertilizer. Urine recycling can take many forms, from decentralized collection points to building-scale systems. At home, urine diversion offers an actionable step to protect your watershed and nourish your garden while replacing the import of synthetic fertilizers. Whether this is the first step of your journey toward bringing urine recycling infrastructure to your community, or you're getting set up to fertilize your own garden, we're glad to have you onboard!